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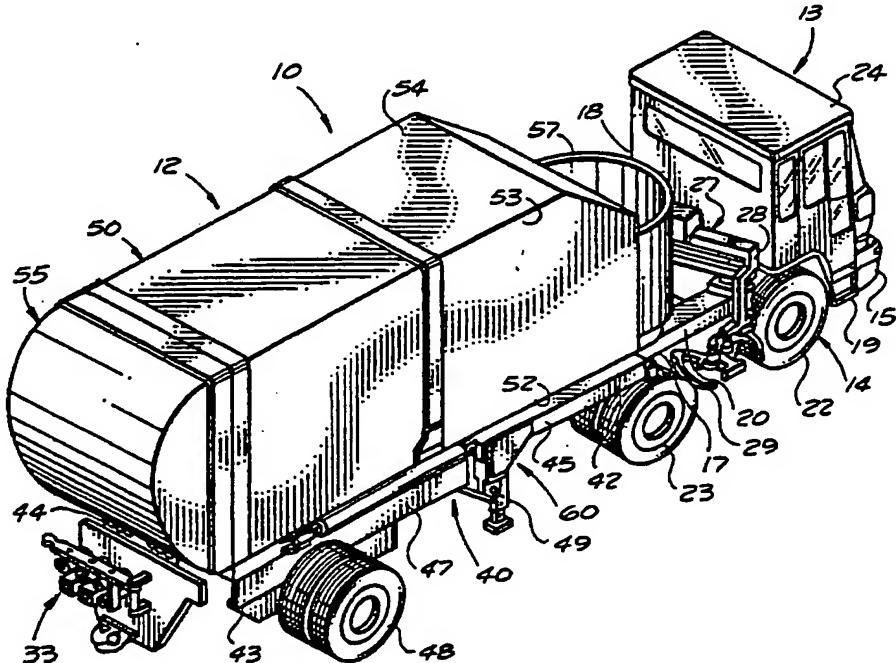
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(54) Title: AN ARTICULATED REFUSE COLLECTION APPARATUS



(57) Abstract

A refuse collection vehicle (10, 190) including a collection towing vehicle (13) having a refuse loading mechanism (27) for loading a semi-trailer (12, 192, 200) coupled to a fifth wheel (25, 124, 140), the semi-trailer having a refuse collection body (50, 211, 212) for receiving refuse from the refuse loading mechanism and a hoist mechanism (60) for tilting the refuse collection body.

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## 1                   AN ARTICULATED REFUSE COLLECTION APPARATUS

2

3                   This application claims priority to U.S. Patent  
4                   Application Serial No. 08/033,127, filed 18 March 1993.

5

6                   Technical Field7                   This invention relates to a refuse collection  
8                   apparatus, and more particularly to an articulated refuse  
9                   collection vehicle. In a further and more specific  
10                   aspect, the present invention concerns the use of a roll-  
11                   off semi-trailer including a removable refuse collection  
12                   body removably carried thereby.

13

14                   Background Art15                   The collection and removal of refuse, the solid  
16                   waste of a community, is a major municipal problem. For  
17                   example, residential refuse is generated at an average  
18                   rate of approximately two pounds per day per capita.  
19                   Other wastes, from commercial or industrial generators,  
20                   typically add another pound. As accumulated, loose and  
21                   uncompacted, the refuse has a density generally in the  
22                   range of 150 to 300 pounds per cubic yard. For the  
23                   health and welfare of the community, regular disposal is  
24                   imperative.25                   Traditionally, residential refuse, including  
26                   garbage, trash, and other waste materials were amassed  
27                   and stored in containers of approximately 10 to 30 gallon  
28                   capacity. On a regular basis, usually once or twice  
29                   weekly, the containers were placed by the householder at  
30                   a designated location for handling by the scheduled  
31                   collection agency. Frequently designated locations were  
32                   curb side and alley line. Not uncommonly, the refuse of  
33                   a single residence, depending upon the number of  
34                   occupants and the frequency of service, would occupy two  
35                   or more containers, each weighing as much as 75 to 100  
36                   pounds. Commercial or industrial generators accumulated  
37                   waste in larger, heavier containers.

1        Conventionally, these refuse containers were emptied  
2        into a refuse collection vehicle which transported the  
3        refuse to a disposal site. Disposal sites could be  
4        landfills, dumps, incinerators, et. cetera. The  
5        conventional refuse collection method involved a  
6        mechanized unit supplemented with manual labor. The  
7        mechanized unit, or collection vehicle, included a refuse  
8        handling body mounted upon a truck chassis. Generally,  
9        the vehicle was attended by a crew of three or more. One  
10       the crew, the driver, attended to operation of the  
11       vehicle while the others, known as collectors, brought  
12       the refuse to the vehicle.

13       Commonly, the vehicle included a hopper of  
14       conveniently low loading height into which the collectors  
15       emptied the containers. Means were provided for  
16       transferring and compacting the refuse from the hopper  
17       into the body. The body also included unloading means  
18       for ejecting the refuse at the disposal site.

19       Recently, considerable effort has been devoted to  
20       developing devices which increase the speed and  
21       efficiency with which refuse is collected. The current  
22       efforts are primarily directed towards automation of the  
23       collection process. These devices generally employ a  
24       self-loading device which engages, lifts, and dumps  
25       refuse containers into the refuse handling body. A wide  
26       variety of self-loading devices have been developed and  
27       are in current use. These include side mounted arms and  
28       front loading arms. The use of these devices greatly  
29       increases the rate of collection.

30       While these self-loading devices greatly increase  
31       the rate at which refuse is collected, they fail to  
32       address pressing problems generated by increasing  
33       population, health concerns, and the increase in refuse  
34       volumes. Generally, these problems revolve around the  
35       transportation of the collected refuse. At this time,  
36       refuse can be collected faster and easier than at any  
37       other time in history, however, disposal of this  
38       collected waste is an ever growing problem.

1       Typically, refuse is transported to a landfill for  
2 disposal. It is common for landfills to be located a  
3 significant distance from the collection area. This is  
4 especially true for large communities. The distance  
5 refuse must be transported is growing quickly as  
6 relatively nearby landfills are filled, and as  
7 regulations limit the number of available sites requiring  
8 the use of more distant landfills.

9       A major problem with transporting refuse to a  
10 distantly located landfill is the increased cost  
11 generated by the need to employ a highly specialized  
12 vehicle, developed for refuse collection, to haul refuse  
13 a great distance. A refuse collection vehicle is very  
14 specialized, requiring heavy and expensive equipment. As  
15 the amount and weight of equipment used increases, to  
16 increase the speed and efficiency with which refuse is  
17 collected, the amount of refuse an individual truck can  
18 carry is reduced. This means the cost of collecting each  
19 pound of refuse is increased due to a reduced payload,  
20 increased cost of the vehicle, and time spent  
21 transporting refuse instead of collecting it.

22     Innovators are attempting to deal with the necessity  
23 of transporting refuse a great distance, and several  
24 options have been developed. Trucks having a large  
25 carrying capacity are being produced. This approach,  
26 however, leads to an expensive truck which is relatively  
27 difficult to maneuver, reducing collection efficiency. A  
28 large refuse collection vehicle will lose time  
29 maneuvering and remaneuvering in order to reach a refuse  
30 container in a tight spot. This somewhat reduces the  
31 efficiency attained by the automated loading mechanism.

32     While the larger vehicles are capable of carrying a  
33 big load, all of the expensive, specialized equipment is  
34 inactive much of the time, and is actually a hindrance  
35 during transportation. The engine on the vehicle must  
36 also be correspondingly larger to transport the heavy  
37 loads to a distant disposal site, adding to weight and  
38 expense of the vehicle. Simply increasing the size of

1 the refuse carrying body carried by the truck chassis  
2 does not prevent the automatic loading mechanism from  
3 being idle while in transport. This is inefficient,  
4 wasting valuable collection time of expensive equipment.

5 In an attempt to eliminate the use of collection  
6 equipment for transportation of refuse to a disposal  
7 site, the use of transfer stations has been developed.  
8 Transfer stations are generally large shed-like  
9 structures located centrally of a collection area.  
10 Refuse collection vehicles collect a load, and travel a  
11 short distance to this central location where they  
12 deposit the refuse. The deposited refuse is then loaded  
13 into transportation vehicles generally consisting of  
14 large open-topped tractor trailer rigs. Large expensive  
15 machinery transfers the deposited refuse into the  
16 transportation vehicles. These vehicles lacking the  
17 heavy self-loading mechanisms and built for long hauls,  
18 efficiently transport large volumes of material to  
19 distant disposal sites. Transfer stations allow refuse  
20 collection vehicles to make additional collection trips  
21 since very little time has been used transporting the  
22 refuse to the transfer station.

23 While this development releases collection equipment  
24 from the need to transport refuse a great distance, it  
25 does require a very expensive structure in a central  
26 location. Transfer stations require a large area in a  
27 conveniently located area easily accessible by large  
28 transport vehicles and refuse collection vehicles.  
29 Locations for transfer stations may be difficult to  
30 obtain due to opposition by local property owners, city  
31 ordinances or other factors. Furthermore, transfer  
32 stations are large expensive structures requiring a large  
33 expenditure for start-up.

34 It would be highly advantageous, therefore, to  
35 remedy the foregoing and other deficiencies inherent in  
36 the prior art.

1            Accordingly, it is an object of the present  
2            invention to provide a new and improved refuse collection  
3            vehicle.

4            Another object of the present invention is to  
5            provide a refuse collection vehicle which will permit  
6            efficient use of time and equipment.

7            And another object of the present invention is to  
8            provide a refuse collection vehicle which is flexible and  
9            will meet substantially any requirements of a community,  
10            accommodating refuse from individual households, from  
11            larger commercial generators or for even larger  
12            commercial or industrial generators.

13            Still another object of the present invention is to  
14            provide a refuse collection vehicle which is articulated  
15            to maintain maneuverability while carrying a large  
16            payload.

17            Yet another object of the present invention is to  
18            provide a refuse collection vehicle which has a semi-  
19            trailer refuse carrier which may be used to collect and  
20            transport refuse.

21            Yet a further object of the present invention is to  
22            provide an articulated refuse collection vehicle which  
23            can grab and dump a refuse container that is essentially  
24            at any angle relative the semi-trailer.

25            And yet a further object of the present invention is  
26            to provide a refuse collection vehicle which does not  
27            require an expensive transfer station while still  
28            transporting refuse a great distance to a disposal site,  
29            collecting and disposing of a large volume of refuse, and  
30            employing a minimum of equipment.

31            A further object of the present invention is to  
32            provide an articulated refuse vehicle which may include a  
33            dolly to which an additional semi-trailer can be coupled.

1        Disclosure of the Invention

2            Briefly, to achieve the desired objects of the  
3 instant invention in accordance with a preferred  
4 embodiment thereof, provided is a refuse collection  
5 vehicle which includes a semi-trailer having a refuse  
6 collection body with a tailgate assembly, a hopper, and a  
7 compacter for moving refuse from the hopper to a storage  
8 area. A coupling assembly pivotally couples the semi-  
9 trailer to a collection tow vehicle having a fifth wheel  
10 and a loader assembly, for collecting refuse.

11            In another embodiment, the refuse collection  
12 vehicle includes a semi-trailer having roll-off rails  
13 mounted on a frame for receiving a refuse collection  
14 body, a winch mechanism coupled to the frame and a hoist  
15 mechanism coupled to the frame.

16            Furthermore, the articulated refuse collection  
17 vehicle may include a dolly having a dolly frame carried  
18 by a set of wheels, a fifth wheel carried by the frame  
19 for couplingly receiving a second semi-trailer, and a tow  
20 coupling assembly coupling the dolly to the first semi-  
21 trailer.

1        Brief Description of the Drawings

2            The foregoing and further and more specific objects  
3            and advantages of the instant invention will become  
4            readily apparent to those skilled in the art from the  
5            following detailed description of the preferred  
6            embodiment thereof taken in conjunction with the drawings  
7            in which:

8

9            Fig. 1 is a perspective view of an articulated  
10          refuse collection vehicle consisting of a semi-trailer  
11          coupled to a collection tow vehicle constructed in  
12          accordance with the teachings of the instant invention;

13

14          Fig. 2 is a side view of the refuse collection  
15          vehicle illustrated in Fig. 1 with the semi-trailer in  
16          the dump position;

17

18          Fig. 3 is a partial perspective view of the hoist  
19          mechanism of the semi-trailer as it would appear coupled  
20          to the collection tow vehicle;

21

22          Fig. 4 is a top view illustrating the various  
23          positions of the collection tow vehicle pivotally coupled  
24          to the semi-trailer, showing the discharge of a refuse  
25          container into the hopper of the semi-trailer;

26

27          Fig. 5 is a top view of a refuse collection vehicle  
28          illustrating the operators visibility;

29

30          Fig. 6 is a partial side elevational view of a  
31          refuse collection vehicle consisting of a semi-trailer  
32          coupled to a collection tow vehicle, illustrating  
33          positioning of the refuse loading mechanism above the  
34          hopper;

35

36          Fig. 7 is a top view of an alternate embodiment of  
37          the refuse collection vehicle illustrating a conventional  
38          compacter mechanism in the hopper of the semi-trailer;

1       Fig. 8 is a side view illustrating a refuse  
2 collection vehicle consisting of tandem semi-trailers  
3 coupled together by a dolly and towed by a transport tow  
4 vehicle;

5

6       Fig. 9 is a side view illustrating a large double  
7 axle semi-trailer coupled to a collection tow vehicle;

8

9       Fig. 10 is a top view illustrating an alternate  
10 embodiment of a refuse collection vehicle, showing a  
11 roll-off semi-trailer coupled to a tow vehicle;

12

13       Fig. 11 is a side view illustrating the refuse  
14 collection vehicle of Fig. 10 with a roll-off semi-  
15 trailer hoisted to the tilt position for positioning a  
16 roll-off container;

17

18       Fig. 12 illustrates a refuse collection vehicle  
19 similar to that illustrated in Figs. 10 and 11 with a  
20 roll-off semi-trailer hoisted to the tilt position for  
21 positioning a removable refuse collection body;

22

23       Fig. 13 illustrates an alternate embodiment of a  
24 refuse collection vehicle showing a semi-trailer coupled  
25 to a collection tow vehicle having a pivotal loading arm  
26 capable of replacing conventional front loading vehicles;  
27 and

28

29       Fig. 14 is a side view of the refuse collection  
30 vehicle illustrated in Fig. 13 showing the dumping action  
31 of the pivotal loading arm.

1      Best Mode for Carrying Out the Invention

2              Turning now to the drawings in which like reference  
3      characters indicate corresponding elements throughout the  
4      several views, attention is first directed to Fig. 1  
5      which illustrates an articulated refuse collection  
6      vehicle generally designated by the reference character  
7      10. Articulated refuse collection vehicle 10 consists of  
8      a semi-trailer 12 and a collection towing vehicle 13.

9              Collection towing vehicle 13 includes a chassis 14,  
10      which, for purposes of orientation in the ensuing  
11      discussion, is considered to have a forward end 15 a  
12      rearward end 17, a left or street side 18 and a right or  
13      curb side 19. Chassis 14 includes a frame 20 supported  
14      above ground level by front wheels 22 and rear wheels 23.  
15      In accordance with conventional practice, front wheels 22  
16      being steerable, provide directional control for the  
17      vehicle. Similarly, rear wheels 23 are caused to rotate  
18      in response to a conventional engine, transmission and  
19      drive train, not specifically illustrated, for propulsion  
20      of the unit. A cab 24, carried at forward end 15 of  
21      chassis 14 provides for an enclosed driver's compartment  
22      including the conventional controls associated with the  
23      manipulation of the chassis as well as conventional  
24      controls associated with the loading and compacting  
25      equipment. A fifth wheel assembly 25, visible in Figs. 2  
26      and 7, is carried at rearward end 17 of frame 20. Fifth  
27      wheel 25 may be any conventional design well known to  
28      those skilled in the art, used in association with a  
29      semi-trailer.

30              A refuse loading mechanism generally designated 27  
31      is carried by frame 20 intermediate cab 24 and fifth  
32      wheel assembly 25. In this preferred embodiment, refuse  
33      loading mechanism 27 consists of an extendable sidearm 28  
34      terminating in a gripping member 29. Those skilled in  
35      the art will understand that various different types and  
36      designs of refuse loading mechanisms may be mounted on  
37      frame 20 for collection of refuse. Additional  
38      embodiments will be discussed below.

1           Various control media such as hydraulic, pneumatic,  
2 and electrical are conventionally supplied to various  
3 equipment by control conduits not specifically  
4 illustrated but well known to those skilled in the art.

5           Still referring to Fig. 1 semi-trailer 12 includes a  
6 trailer chassis 40, which, for purposes of orientation is  
7 considered to have a forward end 42, a rearward end 43, a  
8 left or street side 44, and a right or curb side 45.  
9           Trailer chassis 40 includes a frame 47 supported above  
10 ground level by rear wheels 48 proximate rearward end 43  
11 and landing gear 49 carried intermediate forward end 42  
12 and rearward end 43. A king pin (not specifically  
13 viewable due to its location) extends downwardly from  
14 trailer chassis 40 proximate forward end 42, and is  
15 rotatably and releasable received by fifth wheel assembly  
16 25 for coupling semi trailer 12 to towing vehicle 13.

17           A refuse collection body, generally designated by  
18 the referenced character 50 is carried upon chassis 40.  
19 Refuse collection body 50 is a hollow refuse receiving  
20 and storage receptacle generally defined by a bottom or  
21 lower horizontal panel 52, a pair of spaced apart upright  
22 side panels 53 (only one herein specifically  
23 illustrated), and a top or upper horizontal panel 54. At  
24 rearward end 43, the receptacle is normally closed by a  
25 tailgate assembly 55.

26           An arcuate hopper 57 is formed integral with the  
27 forward portion of refuse collection body 50 proximate  
28 forward end 42. Refuse, received by hopper 57 from  
29 refuse loading mechanism 27, is moved from hopper 57 to  
30 the storage receptacle by a rotating compacter mechanism  
31 58, or swinging platen, coupled to a pivot point within  
32 hopper 57 and rotating about a vertical axis, as can be  
33 seen with further reference to Fig. 4.

34           Referring now to Fig. 4, an articulated refuse  
35 vehicle 10 consisting of collection towing vehicle 13 and  
36 a semi-trailer 12, is illustrated. As can be seen by the  
37 broken lines, collection towing vehicle 13 may be pivoted  
38 about fifth wheel assembly 25, which can be seen in Figs.

1       2 and 6, in relation to semi-trailer 12. The pivoting  
2       movement, permitted by the coupling between the king pin  
3       and fifth wheel assembly 25, allows for high  
4       maneuverability in a relatively large vehicle.

5       Since refuse loading mechanism 27 mounted on  
6       collection towing vehicle 13 discharges a refuse  
7       container in a substantially fixed location relative  
8       collection towing vehicle 13, the highly articulated  
9       nature of articulated refuse vehicle 10 may present a  
10      problem in discharging refuse into hopper 57. In other  
11      words, when collection towing vehicle 13 is angled with  
12      respect to semi-trailer 12, a refuse container engaged by  
13      refuse loading mechanism 27 may not properly discharge  
14      into hopper 57. To overcome this problem, loading  
15      mechanism 27 is configured to empty refuse containers  
16      directly over fifth wheel assembly 25. Furthermore,  
17      hopper 57 is centered generally over the king pin. When  
18      semi trailer 12 is coupled to collection towing vehicle  
19      13, hopper 57 is positioned over fifth wheel assembly 25.  
20      Preferably, the pivot point of compactor 58 is positioned  
21      directly over the king pin. Refuse loading mechanism 27  
22      is mounted, so that refuse is discharged over fifth wheel  
23      assembly 25 and thus the king pin when semi trailer 12 is  
24      coupled to collection towing vehicle 13. Gripper member  
25      29 and refuse loading mechanism 27, of which it is a  
26      part, are positioned so as to discharge refuse from  
27      refuse containers onto the area of the king pin. Since  
28      the distance between the king pin and refuse loading  
29      mechanism 27 does not vary regardless of the orientation  
30      of collection towing vehicle 13 with semi-trailer 12, and  
31      hopper 57 is positioned with the pivot point of compactor  
32      58 over the king pin, refuse loading mechanism 27 will  
33      always discharge refuse from the refuse containers  
34      directly into hopper 57.

35      While a variety of hoppers with associated compactor  
36      mechanisms may be used, arcuate hopper 57 with a swinging  
37      platen 58 is preferred. Arcuate hopper 57 is preferred  
38      for reasons of increased visibility for the

1 operator/driver, as can be seen with additional reference  
2 to Fig. 5. The operator/driver seated on the left or  
3 street side of cab 24 must be able to visually follow the  
4 operation of gripping member 29 of refuse loading  
5 mechanism 27 and the area about the refuse container to  
6 be gripped. The rounded off sides of arcuate hopper 57  
7 permit a wider field of view for the operator/driver when  
8 a side mounted refuse loading mechanism, extending from  
9 the side opposite the operator/driver, is used. Using  
10 arcuate hopper 57 permits increased visibility when the  
11 highly articulated semi-trailer is in any of the numerous  
12 positions of which it is capable, as shown in Fig. 4.

13 Arcuate hopper 57 using swinging platen 58, also  
14 allows continuous deposit of refuse into the hopper,  
15 without requiring the operator to wait for the compactor  
16 to complete its cycle before depositing refuse. This  
17 permits large volumes of refuse to be deposited into  
18 hopper 57 at one time.

19 Fig. 6 illustrates the retraction of sidearm 28 to  
20 position gripper 29 of refuse loading mechanism 27 above  
21 hopper 57. As can be seen gripper 29 is directly above  
22 fifth wheel assembly 25 and thus hopper 57.

23 Fig. 7 illustrates the use of a square hopper 59  
24 with a reciprocating compacter 61, replacing arcuate  
25 hopper 57 with rotating compacter 58. Either one may be  
26 used since the refuse loading mechanism 27 is aligned to  
27 discharge refuse directly over the king pin which is  
28 positioned generally under the center region of the  
29 hopper.

30 Semi-trailer 12 may also include a refuse ejecting  
31 apparatus for emptying refuse from semi-trailer 12. The  
32 refuse ejecting apparatus may be conventional apparatus,  
33 or a unique hoist mechanism 60 functioning as part of  
34 chassis 40. Hoist mechanism 60 includes an end pivotally  
35 coupled to frame 47, and an opposing end terminating in a  
36 coupling assembly 62. In this embodiment, coupling  
37 assembly 62 including a king pin (not visible), which is  
38 received by fifth wheel assembly 25 of collection tow

1       vehicle 13. Hoist mechanism 60 will be discussed in  
2       greater detail below.

3       Referring now to Figs. 2 and 3, trailer frame 47  
4       consists of parallel spaced apart longitudinal channel  
5       beams 67, having a top surface 68, an outer side surface  
6       69, and a bottom surface 70, and landing gear 49. Frame  
7       47 is coupled to collection tow vehicle 13 by hoist  
8       mechanism 60. Landing gear 49 each include a generally  
9       square tube 72, extending vertically downward from bottom  
10      surface 70 of channel beams 67. Adjustable legs 73 are  
11      received by square tubes 72 and are adjustably held in  
12      place by pins 74 extending through bores 75 formed in  
13      square tube 72 and corresponding bores in 77 in legs 73.  
14      The series of vertical tube bores 75 in square tube 72  
15      allow legs 73 to be adjusted upward or downward as  
16      desired. This adjustability allows for use on varied  
17      fifth wheel heights and differing ground conditions. A  
18      strut 78 extends from square tube 72 rearward and upward,  
19      attaching to bottom surface 70 of channel beams 67.

20      Hoist mechanism 60 consists of parallel spaced apart  
21      generally L-shaped members 80 having horizontal main  
22      portions 82 with a terminal end 83 and a boss end 84. A  
23      vertical leg portion 85 depends downward from boss end 84  
24      of generally L-shaped members 80 terminating in a  
25      terminal end 87. Terminal ends 83 of main portion 82 are  
26      pivotally coupled to opposing sides of a top surface 88  
27      of a plate 89. A clevis connection pivotally couples  
28      terminal ends 83 to top surface 88 of plate 89. The  
29      clevis connections each consist of a bifurcated bracket  
30      90 having inner and outer furcations spaced to receive  
31      terminal end 83 of main portion 82 therebetween. A bore  
32      92 is formed through the furcations of bifurcated bracket  
33      90 and a bore 93 is formed through terminal end 83 of  
34      main portion 82. A pin 94 is received by bores 92 and 93  
35      thereby pivotally connecting main portion 92 to plate 89.  
36      A king pin (not shown) extends downward from plate 89,  
37      forming coupling assembly 62, for rotational engagement  
38      with fifth wheel assembly 25.

1       L-shaped members 80 are pivotally coupled to trailer  
2       frame 47 so as to be positioned to the outside of channel  
3       beams 67, parallel therewith in a lowered position. An  
4       attachment member 100 extends downward from terminal end  
5       87 of vertical leg 85, and has a bore 102 formed  
6       therethrough. A socket 103 having a bore 104 is formed  
7       at the junction of strut 78 and square tube 72, and is  
8       configured to align with bore 102 of attachment member  
9       100 to receive a pin 105. Pin 105 is journaled in bores  
10      102 and 104 allowing pivotal movement between trailer  
11      frame 47 and L-shaped members 80.

12      Semi-trailer 12 is hoisted by pivoting trailer frame  
13      47 and L-shaped members 80 at socket 103. The pivoting  
14      movement is achieved by a motor means, which in this  
15      embodiment is a hoist cylinder assembly 107 residing on  
16      outer side surfaces 69 of channel beams 67. Hoist  
17      cylinder assembly 107 includes a cylinder 108 and  
18      reciprocally moveable operating rod 109 which is  
19      extendable in response to the introduction of pressurized  
20      fluid into cylinder 108 in accordance with conventional  
21      practice. Cylinder 108 terminates at one end with an  
22      attachment member 110 pivotally secured to a bifurcated  
23      bracket 112 by a bolt and nut assembly 113. Bifurcated  
24      bracket 112 is affixed to outer side surface 69 of  
25      channel beams 67. Bifurcated bracket 112, in this  
26      embodiment, is attached to a flange extending from outer  
27      side surface 69 of channel beam 67. Although only one  
28      hoist cylinder assembly 107 is specifically seen in the  
29      drawings, it will be appreciated that a hoist cylinder  
30      assembly 107 resides on outer side surfaces 69 of each  
31      channel beam 67. Operating rod 109 terminates at the  
32      free end with eye 114. A boss 118 extends from boss end  
33      84 of main portion 82 terminating in a bifurcated bracket  
34      117 configured to receive eye 114 between furcations  
35      thereof. A nut and bolt assembly 115 extends through  
36      bifurcated bracket 117 and eye 114 pivotally securing  
37      reciprocating operating rod 109 to L-shaped members 80.

1 For added stability and support, cross pieces 119 extend  
2 between L-shaped members 80.

3 With cylinder assembly 107 in the retracted  
4 position, L-shaped members 80 reside in a substantially  
5 horizontal orientation. In response to the introduction  
6 of pressurized fluid into cylinder 108, operating rod 109  
7 is extended in the direction indicated by arrowed line A  
8 urging L-shaped member 80 to pivot upward about the axis  
9 provided by pins 94 as indicated by the arrowed line B.  
10 As reciprocating operating rod 109 continues to be  
11 extended, trailer frame 47 pivots about the axis provided  
12 by pin 105 as indicated by the arrowed line C, resulting  
13 in the forward end of frame 47 pivoting upward about rear  
14 wheels 48. Hoist cylinder assembly 107 pivots about the  
15 axis provided by nut and bolt assembly 113 in the  
16 direction indicated by the arrowed line D as seen in Fig.  
17 2. As operating rod 109 is extended, trailer frame 47  
18 pivots upward about the axis provided by rear wheels 48  
19 as indicated by the arrowed line E.

20 When in the hoisted position, the refuse carried in  
21 refuse collection body 50 of semi-trailer 12 may be  
22 dumped out an opened tailgate assembly 55. The angle of  
23 bottom 52 is sufficient, when hoisted, to allow refuse to  
24 slide out without requiring any additional mechanism for  
25 ejecting it through the tailgate assembly.

26 In an alternate configuration, semi-trailer 12 may  
27 be coupled to a dolly 120 as illustrated in Fig. 8.  
28 Dolly 120 allows a towing vehicle to tow more than one  
29 semi-trailer 12, in a tandem configuration. The tandem  
30 configuration is illustrated in Fig. 8, which shows an  
31 alternate embodiment 121 of articulated refuse vehicle  
32 10. Dolly 120 is coupled to the rearward end of trailer  
33 frame 47. Dolly 120 consists of a dolly frame 122  
34 carried by a set of wheels 123. A fifth wheel assembly  
35 124 is carried by frame 122 for rotational coupling with  
36 coupling assembly 62. Various control media such as  
37 hydraulic, pneumatic, and electrical are conventionally  
38 supplied to various equipment by control conduits not

1 specifically illustrated but well known to those skilled  
2 in the art. These control media are supplied to dolly  
3 120 for control of a coupled semi-trailer 12 by control  
4 conduits coupled between semi-trailers in any manner  
5 known to those skilled in the art. Dolly 120 may be  
6 coupled to a semi-trailer 12 or a towing vehicle, by a  
7 tow coupling assembly, which in this embodiment is  
8 preferably a pintle hitch consisting of a female element  
9 127 extending from dolly frame 122 of dolly 120, and a  
10 male element 128 extending from frame 47 of semi-trailer  
11 12.

12 Still referring to Fig. 8, it can be seen that a tow  
13 vehicle lacking a refuse loading mechanism 27, is towing  
14 semi-trailer 12 to which dolly 120 is coupled. The  
15 vehicle illustrated is a transport towing vehicle  
16 generally designated 130, which would be used to replace  
17 collection towing vehicle 13 for transport purposes. The  
18 use of transport towing vehicle 130 to transport semi-  
19 trailer 12 to a disposal site, frees collection towing  
20 vehicle 13 to use its specialized equipment, specifically  
21 refuse loading mechanism 27, to collect more refuse.  
22 Transport towing vehicle 130 consists of a chassis 132,  
23 which, for purposes of orientation throughout the ensuing  
24 discussion, is considered to have a forward end 133 and a  
25 rearward end 134. Chassis 132 includes a frame 135  
26 supported above ground level by front wheels 137 and rear  
27 wheels 138. In accordance with conventional practice,  
28 front wheels 137, being steerable, provide directional  
29 control for the vehicle. Similarly, rear wheels 138, are  
30 caused to rotate in response to a conventional engine,  
31 transmission and drivetrain, not specifically  
32 illustrated, for propulsion of the unit. A cab 139,  
33 carried at the forward end 133 of frame 135, provides for  
34 an enclosed driver's compartment including the  
35 conventional controls associated with manipulation of  
36 chassis 132 in addition to the controls for operating the  
37 semi-trailers. A fifth wheel assembly 140, generally of  
38 a conventional configuration, is carried by frame 135

1 towards rearward end 134. Fifth wheel assembly 140  
2 rotatably receives coupling assembly 62 of semi-trailer  
3 12.

4 Embodiment 121 of an articulated refuse vehicle,  
5 consists of transport towing vehicle 130 towing a first  
6 semi-trailer 12a, and a second semi-trailer 12b. Second  
7 trailer 12b is coupled to trailer 12a by a dolly 120. In  
8 this illustration, second semi-trailer 12b is illustrated  
9 with hoist mechanism 60 activated, tilting refuse  
10 collection body 50 into a dump position. Tailgate  
11 assembly 55 has been raised allowing refuse to be dumped.  
12 This illustration shows that semi-trailers 12 may be  
13 controlled and activated while attached to dollies 120  
14 and illustrates that trailers may be discharged from  
15 either dollies 120 or vehicles such as 130 or 13.

16 Transport towing vehicle 130 may be substantially  
17 identical to collection towing vehicle 13, without refuse  
18 loading mechanism 27. Preferably, a transport towing  
19 vehicle 130 has a larger engine to facilitate hauling of  
20 large amounts of refuse over long distances. Collection  
21 towing vehicle 13 typically, has a smaller engine,  
22 reducing the cost of the vehicle, since only relatively  
23 short distances must be traversed, requiring less power.  
24 The numerous components described, provide a very  
25 flexible refuse collection vehicle.

26 Fig. 9 illustrates a further embodiment generally  
27 designated 190 of an articulated refuse vehicle  
28 consisting of a single, double axle trailer 192. Semi-  
29 trailer 192 is substantially identical to semi-trailers  
30 12, with increased dimensions, and a double axle 193 to  
31 support heavier loads. Semi-trailer 192 is hauled by a  
32 collection towing vehicle 13 as described above. Semi-  
33 trailer 192 may be dimensioned to carry a volume of  
34 approximately 50 cubic yards. It may have a payload of  
35 approximately 15 tons. For many haulers, 15 tons is a  
36 days work for collecting and hauling. Since the wheel  
37 base from rear wheels 23 of collection towing vehicle 13  
38 to the double axle 193 of semi-trailer 192 is about the

1 same as for a conventional 30 cubic yard body mounted on  
2 a conventional truck chassis, the combination is at least  
3 as maneuverable, due to the articulation, with one and  
4 one half times the payload capacity.

5 Turning now to Figs. 10, 11 and 12, an alternate  
6 embodiment of a semi-trailer generally designated 200 is  
7 illustrated. Semi-trailer 200 consists of a trailer  
8 chassis 202 having a forward end 203 and a rearward end  
9 204. Chassis 202 includes a frame 205 supported by rear  
10 wheels 207 located at rearward end 204, landing gear 208  
11 located approximate forward end 203 and a hoist mechanism  
12 209, substantially identical to hoist mechanism 60  
13 described above. Hoist mechanism 209 couples frame 205  
14 to fifth wheel assembly 140 of transport towing vehicle  
15 130. Those skilled in the art will understand that  
16 other, conventional hoist mechanisms may be employed,  
17 replacing hoist mechanism 209. A rail assembly 210 is  
18 carried by frame 205, to receive a refuse collection  
19 body. In Fig. 10 and 11, a refuse collection body 212  
20 consists of a large, generally rectangular roll off  
21 refuse container having sidewalls 213, endwalls 214 and a  
22 bottom 215. Wheels 217 are carried by bottom 215 and are  
23 receivable on rail assembly 210. Referring to Fig. 12, a  
24 removable refuse collection body 211 consists of a refuse  
25 collection body 50 and a hopper 57, as described  
26 previously in connection with Fig. 1, mounted upon a  
27 frame 216. A winch assembly 218, not visible, coupled to  
28 chassis 202, aids in loading removable refuse collection  
29 body 211 and 212.

30 To load removable refuse collection body 211 or 212  
31 onto semi-trailer 200, hoist mechanism 209 is activated,  
32 tilting frame 205 upward. A cable 219 is coupled from  
33 winch assembly 218 to removable refuse collection body  
34 211 or 212. Wheels 217 of removable collection body 212  
35 and frame 216 of removable collection body 211, are  
36 received by rail assembly 210 and pulled gradually upward  
37 along rail assembly 210 by winch assembly 218. Once  
38 removable refuse collection body 211 or 212 is fully

1       winched onto rail assembly 210, hoist mechanism 209 is  
2       lowered. A filled removable refuse collection body 211  
3       or 212 may now be transported to a disposal site, or  
4       delivered empty to a new location. Figs. 10 and 11  
5       illustrate semi-trailer 200 coupled to a fifth wheel  
6       assembly 140 of tow vehicle 130 not equipped with a  
7       refuse loading mechanism, while Fig. 12 shows semi-  
8       trailer 200 coupled to collection tow vehicle 13 having a  
9       refuse loading mechanism which operates in a manner  
10      described above.

11      Semi-trailer 200 may be used in combination with  
12      semi-trailers 12, and carried by dollies 120. It may be  
13      emptied by tilting hoist mechanism 209 attached to either  
14      dolly 120 or a vehicle such as 130. This allows the  
15      refuse collection vehicle to be tailored to a community  
16      which requires large containers for dumping bulk refuse  
17      or a community which desires one vehicle capable of  
18      carrying a variety of items for different uses, such as  
19      removable refuse collection body 211.

20      Referring now to Figs. 13 and 14, an alternate  
21      embodiment of a collection towing vehicle generally  
22      designated 260 is illustrated. Collection vehicle 260 is  
23      substantially similar to collection towing vehicle 13,  
24      including a chassis 14 a frame 20 and a fifth wheel  
25      assembly 25. While generally analogous, the immediate  
26      embodiment 260 differs by virtue of a pivotal loader arm  
27      262 mounted adjacent a cab 263 in a space 264 defined by  
28      cab 263 and curb side 19 of frame 20. Pivoting loader  
29      arm 262 consists of an arm 267, which is telescopingly  
30      extendable, having a pivot end 268, pivotally attached  
31      to a clevis fitting 269 for pivotal movement in a  
32      vertical direction. Clevis fitting 269 consists of a  
33      bifurcated bracket 270 pivotally mounted to frame 20 in  
34      space 264. Bifurcated bracket 270 rotates horizontally,  
35      swinging pivoting loader arm 262 in an arch, illustrated  
36      by arrowed line F. Horizontal rotation is achieved by  
37      motor means, which may be any conventional rotary or  
38      reciprocating drive mechanism, positioned beneath space

1        264 and not visible. A pin 272 extends through  
2        bifurcated bracket 270 and pivot end 268 of arm 267. A  
3        pivot cylinder 273 coupled between clevis fitting 269  
4        proximate frame 20 and a terminal end 274 of arm 267,  
5        pivots arm 267 about the axis provided by pin 272 as  
6        indicated by the arrowed line G. A lifting attachment  
7        275 is coupled to terminal end 274 of arm 267.

8        As can be seen in Figs. 13 and 14, lifting  
9        attachment 275 of pivoting loader arm 262 may engage a  
10       refuse container in a forward direction or at  
11       intermediate locations around to the side as illustrated  
12       by broken line 276. To empty the refuse container into  
13       hopper 57, pivoting loader arm 262 must be rotated until  
14       it is directed in a substantially forward direction, to  
15       ensure deposit of refuse into hopper 57. Pivoting loader  
16       arms such as 262 are familiar to those skilled in the  
17       art.

18       Various changes and modifications to the embodiment  
19       herein chosen for purposes of illustration will readily  
20       occur to those skilled in the art. To the extent that  
21       such modifications and variations do not depart from the  
22       spirit of the invention, they are intended to be included  
23       within the scope thereof which is assessed only by a fair  
24       interpretation of the following claims.

1      Industrial Applicability

2      The present invention is capable of being exploited  
3      in any situation where refuse is required to be collected  
4      and transported to a distant site. The present invention  
5      is particularly appropriate for large rural areas  
6      generating large volumes of refuse, and areas requiring  
7      diverse refuse collection techniques.

## CLAIMS

1. An articulated refuse collection vehicle for collecting and transporting refuse comprising:

- a) a collection towing vehicle including:
  - i) a chassis having a rearward end and a forward end;
  - ii) a fifth wheel carried by said chassis proximate said rearward end;
  - iii) a cab carried by said chassis proximate said forward end;
  - iv) a refuse loading mechanism carried by said chassis intermediate said cab and said fifth wheel for emptying refuse containers above said fifth wheel; and
- b) a semi trailer rotatably and removably coupled to said fifth wheel of said towing vehicle.

2. An articulated refuse collection vehicle as claimed in claim 1 wherein said semi-trailer includes:

- a) a chassis having a forward end, a rearward end, and a frame carried by rear wheels proximate said rearward end; and
- b) a king pin coupled to and extending downward from said chassis proximate said forward end, said king pin rotatably and removably received by said fifth wheel; and
- c) a refuse collection body carried by said chassis.

3. An articulated refuse collection vehicle as claimed in claim 2 wherein said refuse collection body includes:

- a) a storage receptacle having a forward end and a rearward end;

- b) a hopper coupled to said forward end of said storage receptacle, said hopper being positioned directly above said king pin for receiving refuse;
- c) a compacter carried by said hopper; and
- d) a tailgate assembly coupled to said rearward end of said storage receptacle.

4. An articulated refuse collection vehicle as claimed in claim 2 wherein said semi-trailer further includes:

- a) roll-off rails mounted on said frame for receiving said refuse collection body;
- b) a winch mechanism coupled to said frame;

and

- c) a hoist mechanism coupled to said frame.

5. An articulated refuse collection vehicle as claimed in claim 4 wherein said refuse collection body includes:

- a) a storage receptacle having a forward end and a rearward end;
- b) a hopper coupled to said forward end of said storage receptacle, said hopper being positioned directly above said king pin for receiving refuse;
- c) a compacter carried by said hopper; and
- d) a tailgate assembly coupled to said rearward end of said storage receptacle.

6. An articulated refuse collection vehicle as claimed in claim 5 wherein said hoist mechanism includes:

- a) a first and a second generally L-shaped member each having a main portion and a leg portion, said main portion and said leg portion each include a terminal end and an opposite end, with the opposite

ends being attached so as to form an angle therebetween;

- b) said terminal ends of each said main portions being pivotally attachable to said collection tow vehicle;
- c) said terminal ends of each said leg portion being pivotally attached to said frame of said semi-trailer; and
- d) motor means coupled between said frame and said angle for pivoting said generally L-shaped member about said terminal ends so as to move said semi-trailer frame between a retracted position and a tilt position.

7. An articulated refuse collection vehicle as claimed in claim 6 wherein said terminal ends of said main portions of said first and said second generally L-shaped members, are pivotally coupled to said collection tow vehicle by means of a coupling assembly.

8. An articulated refuse collection vehicle as claimed in claim 7 wherein said coupling assembly includes:

- a) a plate having an top surface and a bottom surface; and
- b) said king pin extending downward from said bottom surface of said plate.

9. An articulated refuse collection vehicle as claimed in claim 8 wherein said hopper is carried by said frame, centered over said king pin in said retracted position.

10. An articulated refuse collection vehicle as claimed in claim 1 further comprising a dolly having a dolly frame carried by a set of wheels, a fifth wheel

FIG. 1

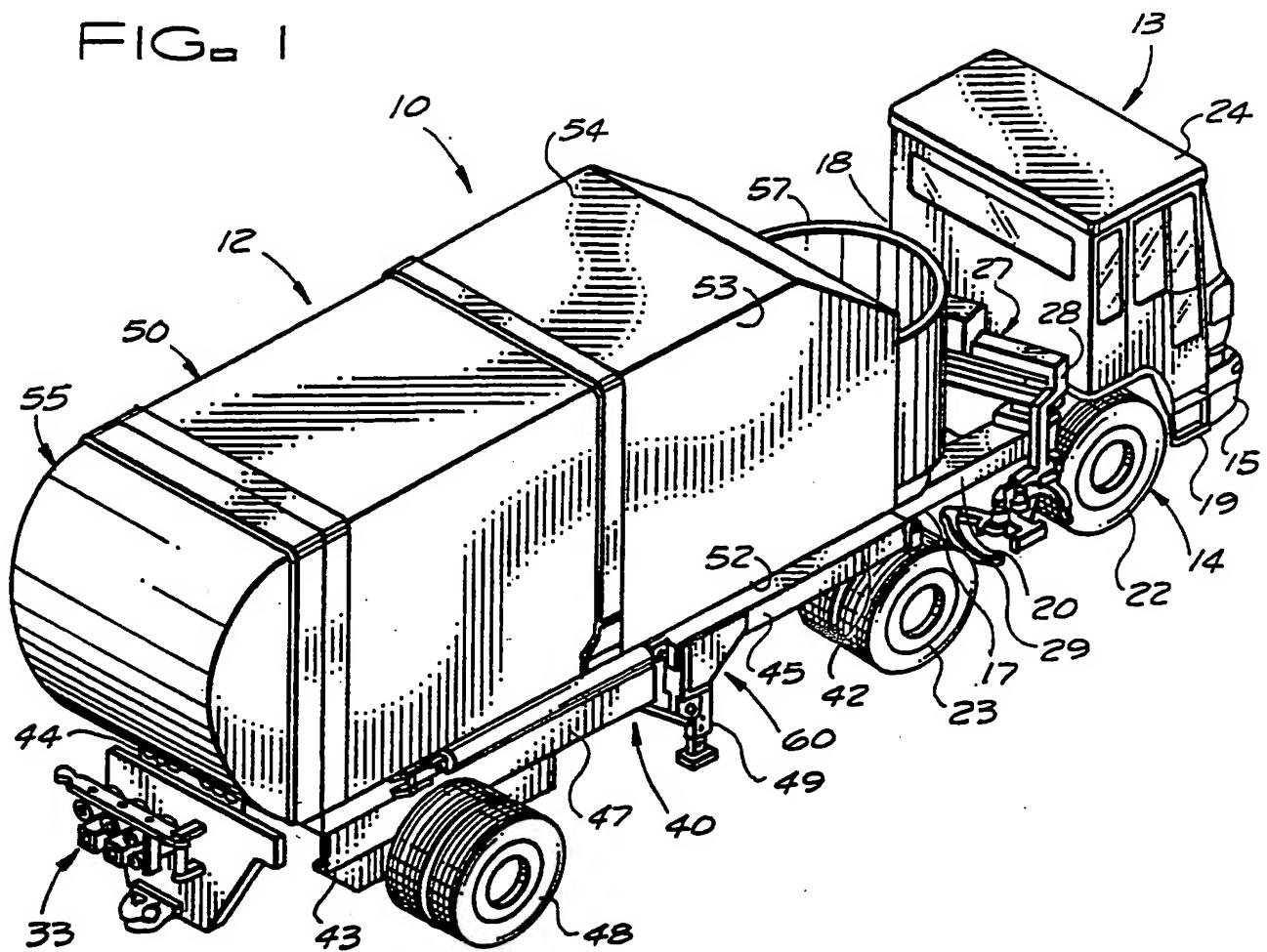
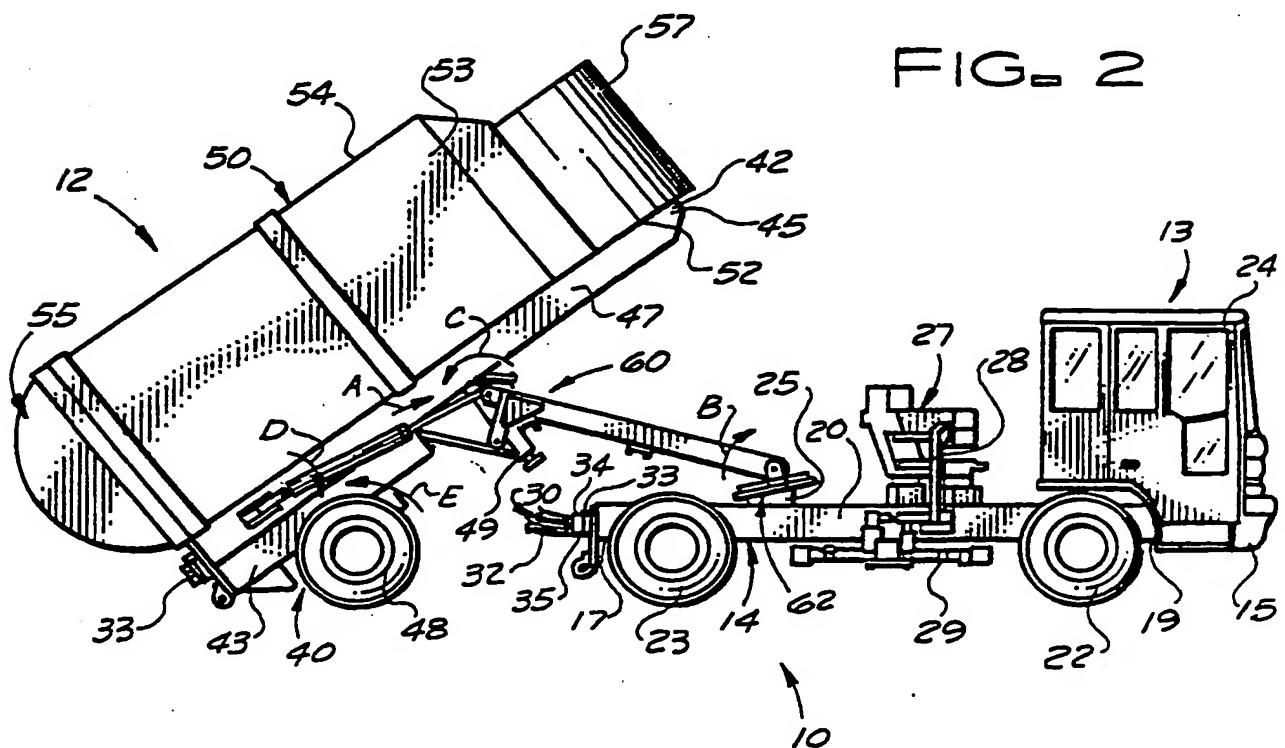


FIG. 2



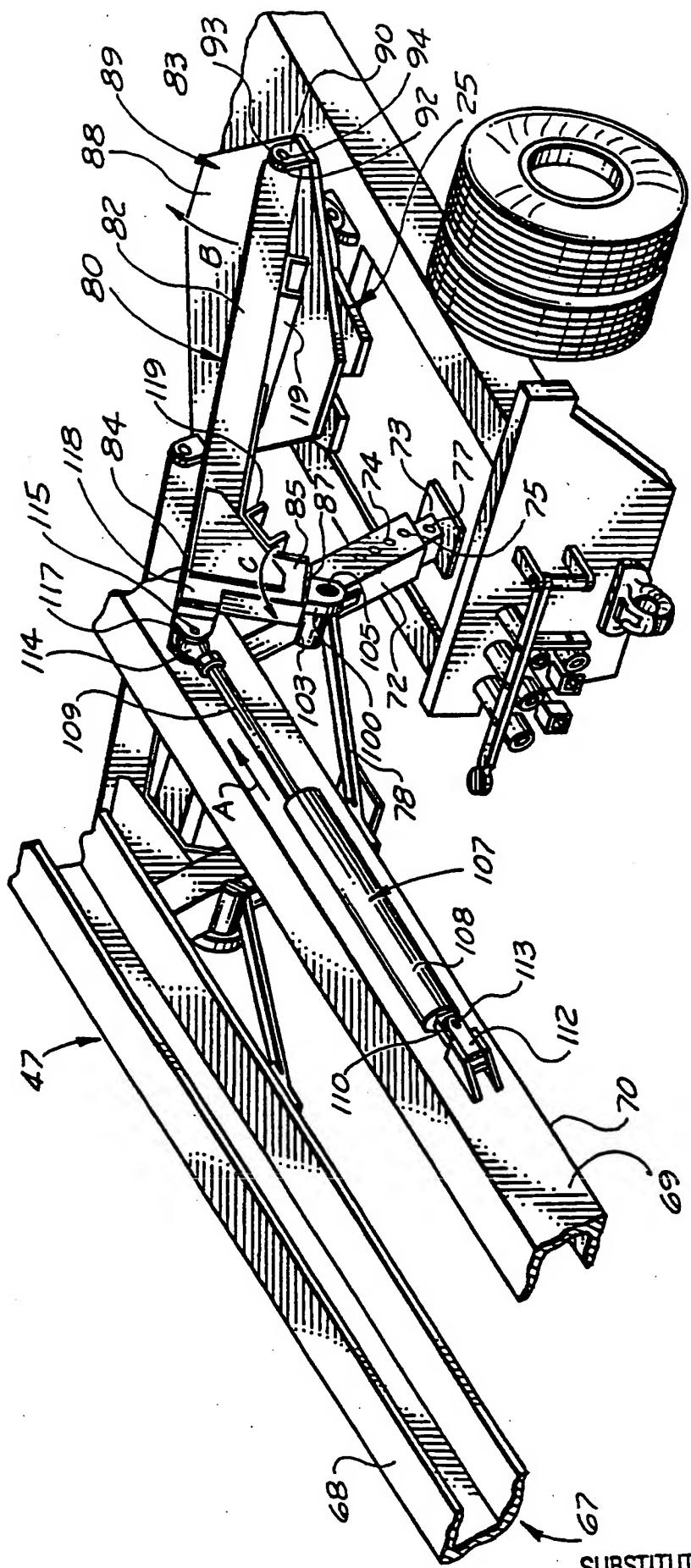


FIG. 3

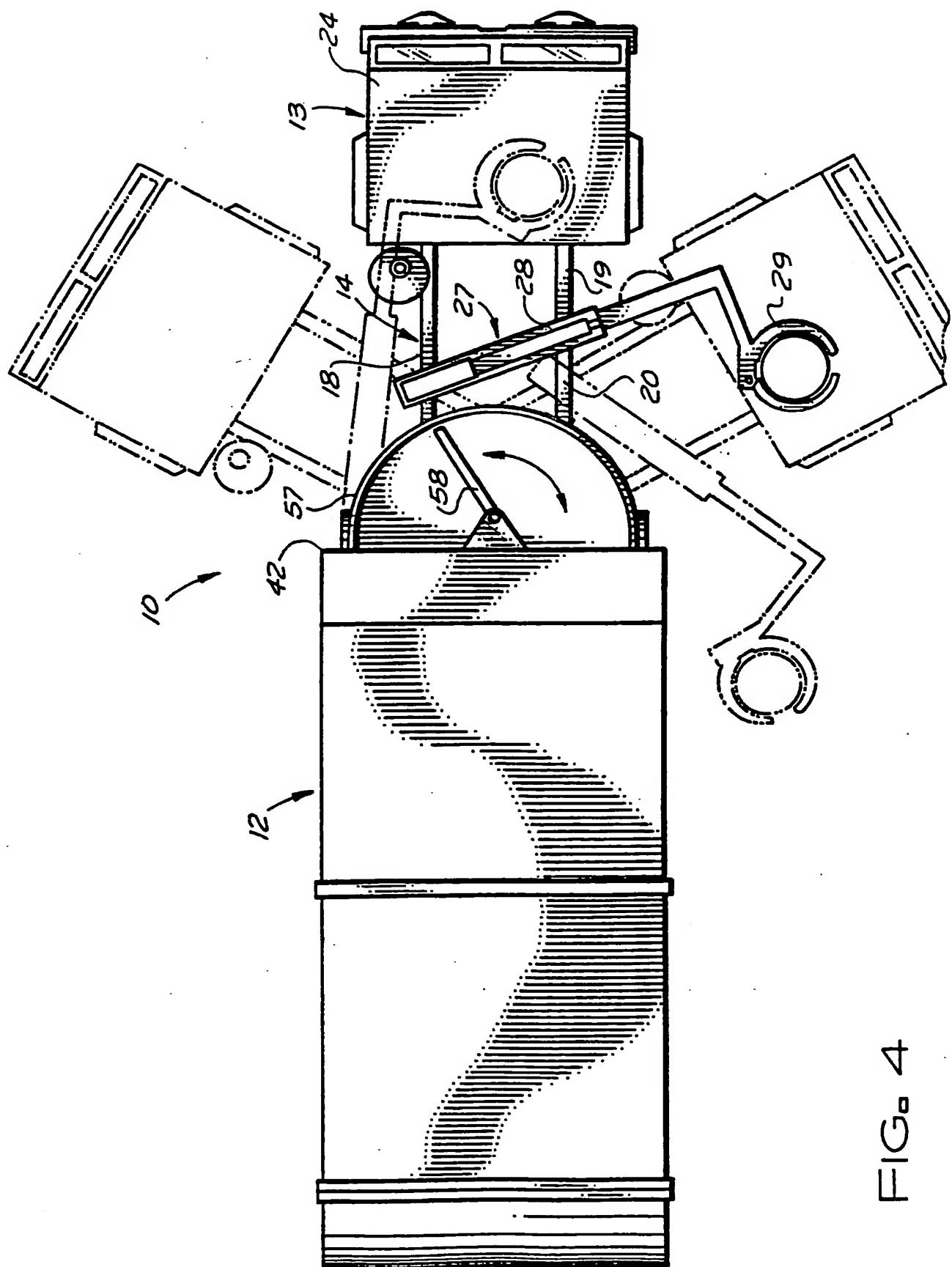


FIG. 4

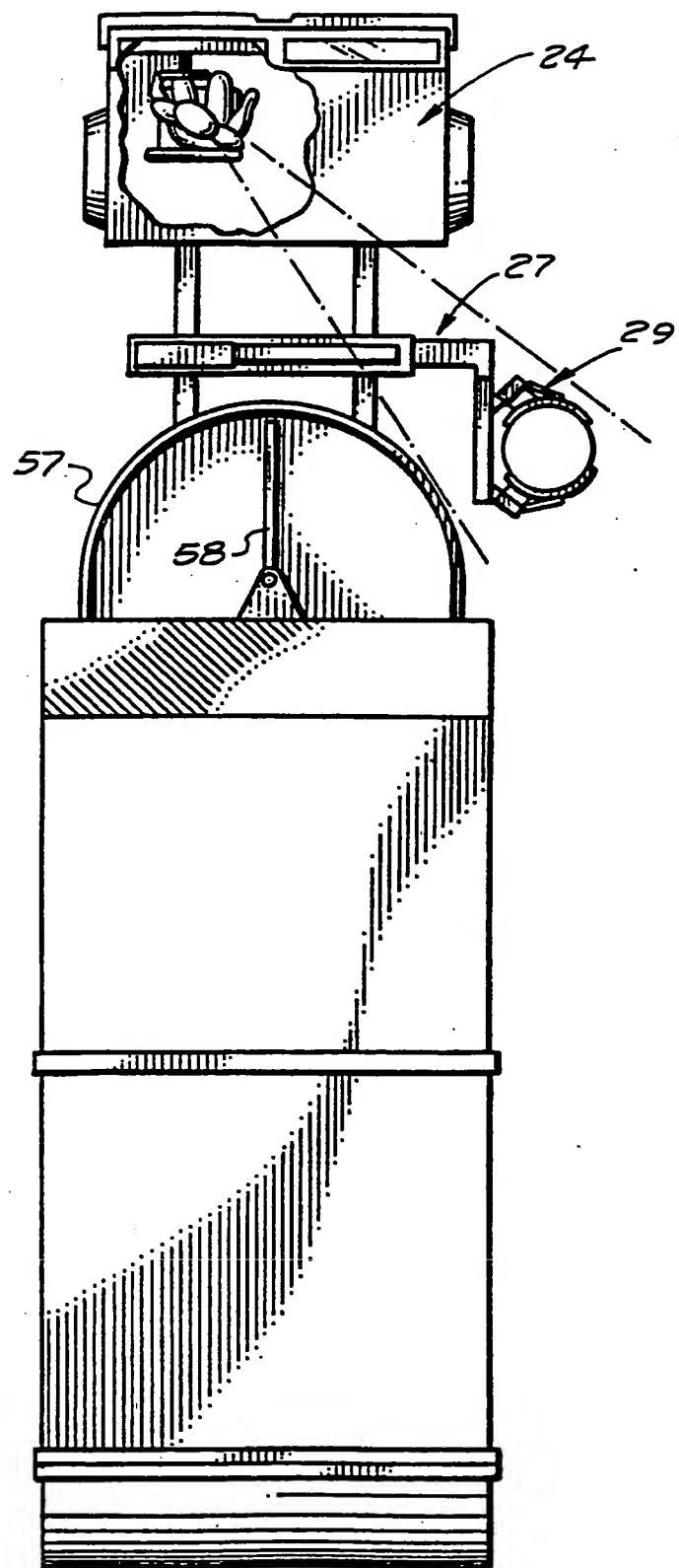


FIG. 5

SUBSTITUTE SHEET (RULE 26)

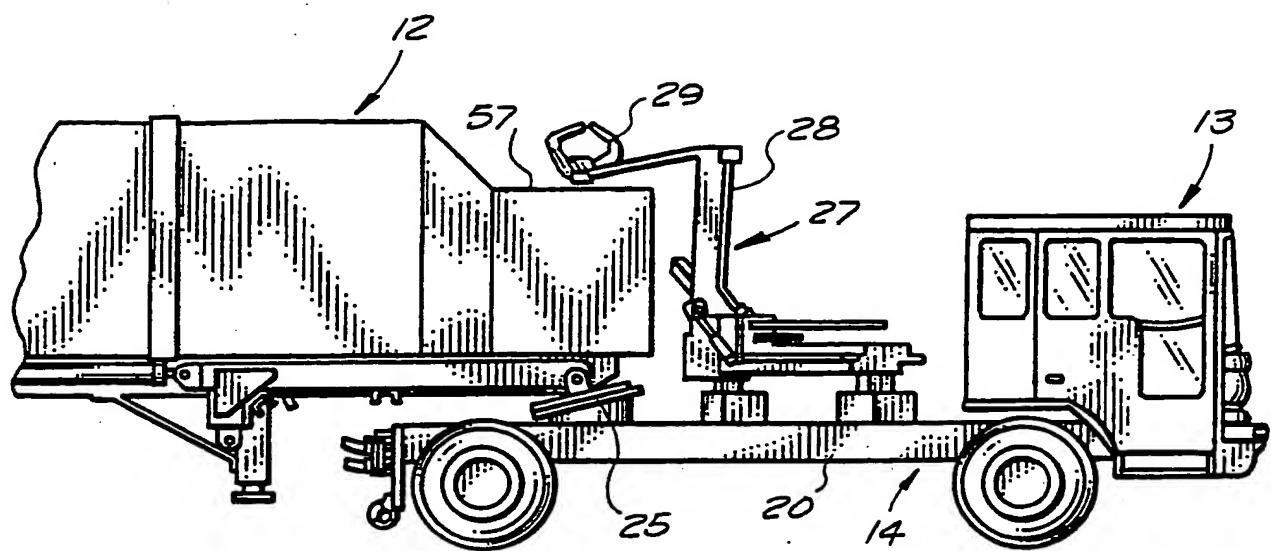


FIG. 6

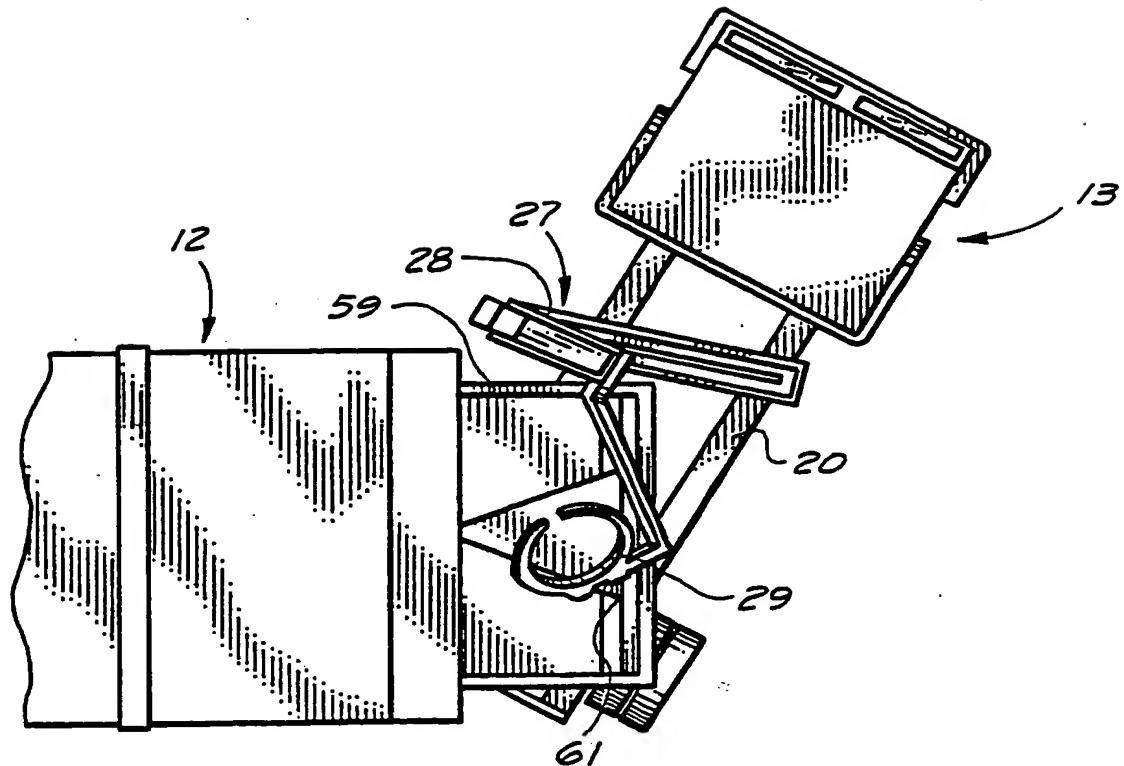


FIG. 7

FIG. 8

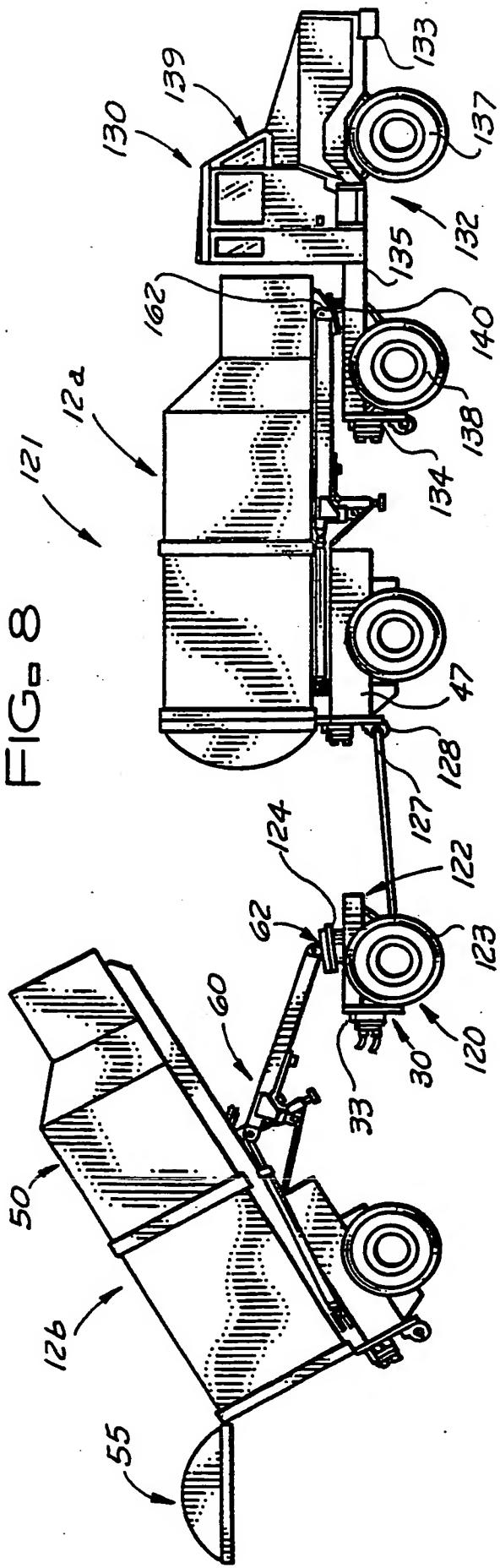
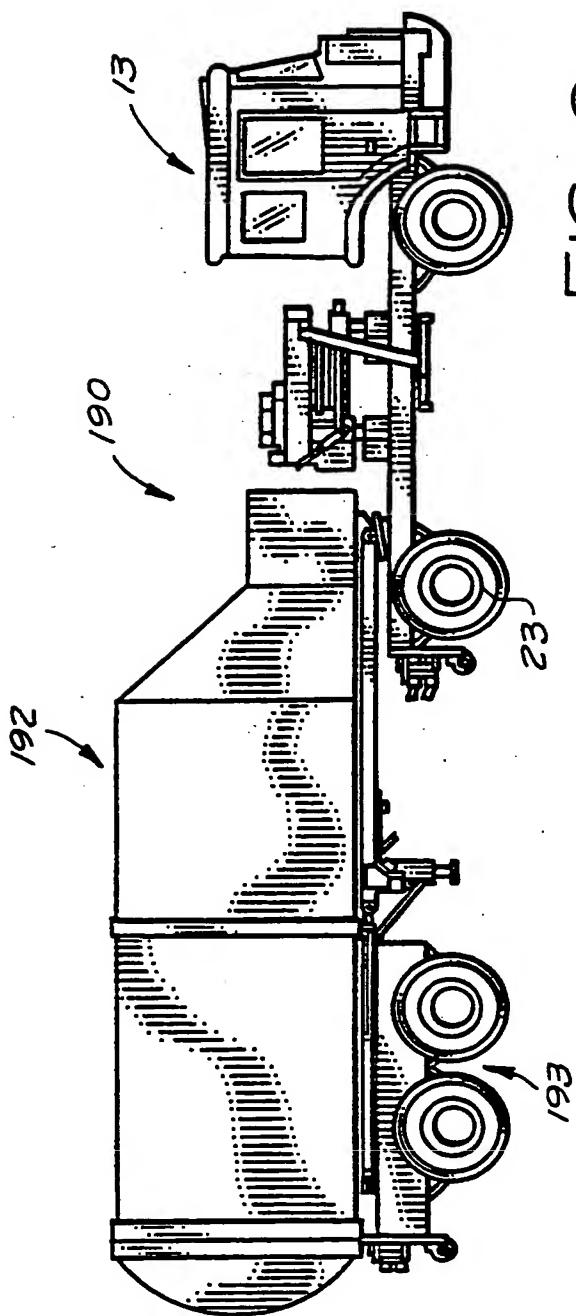


FIG. 9



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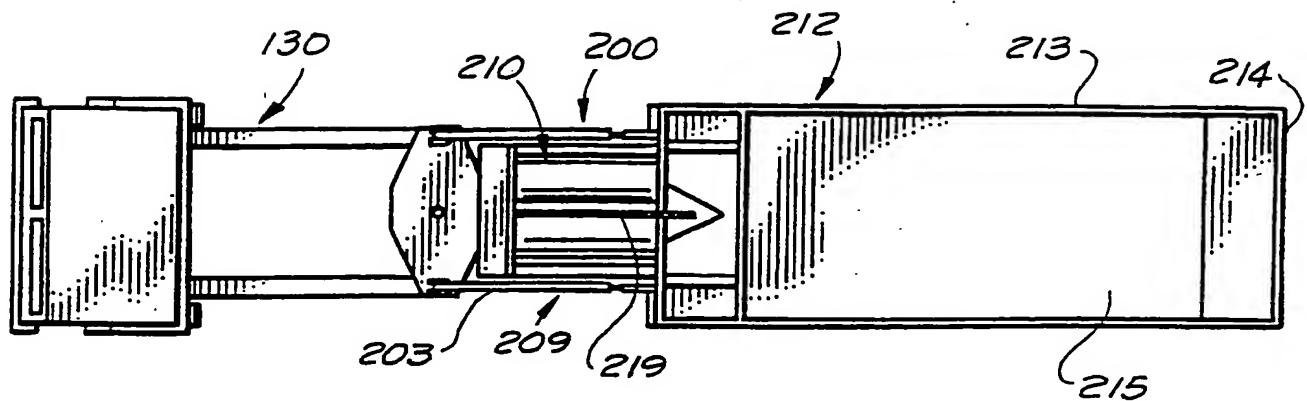


FIG. 10

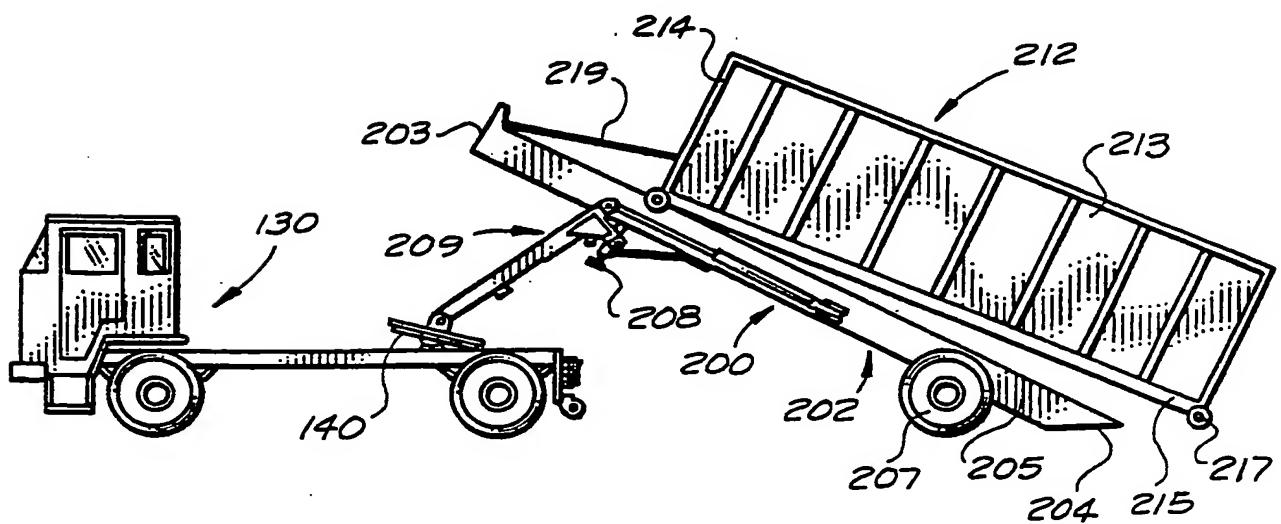


FIG. 11

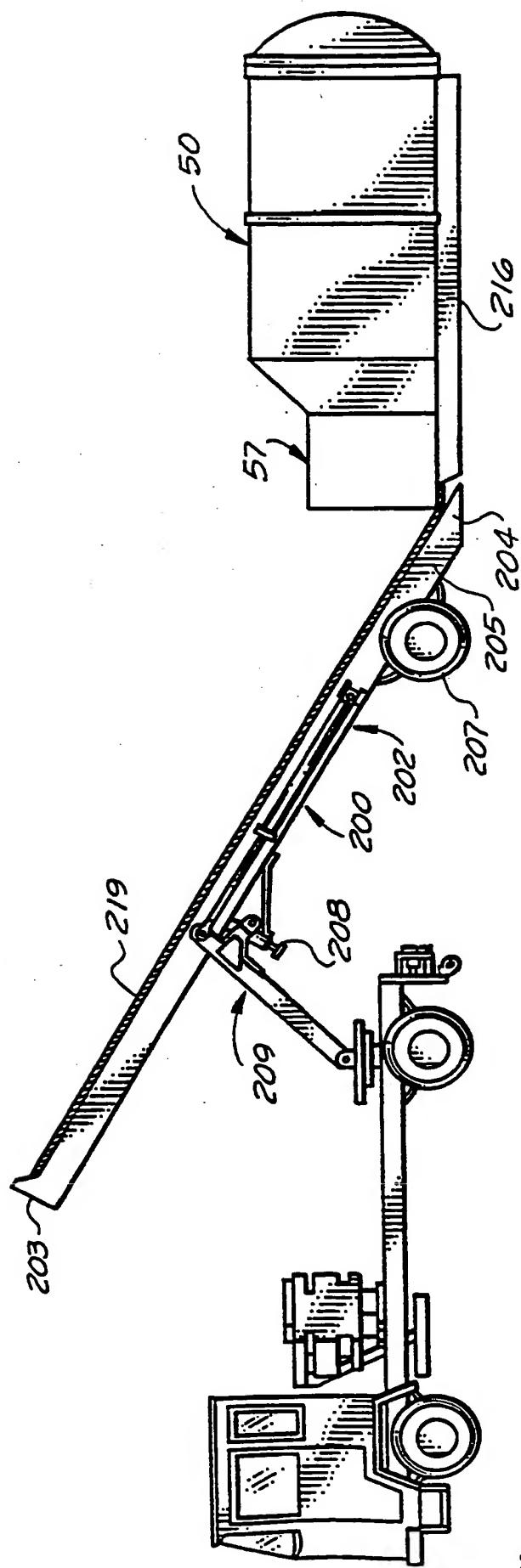
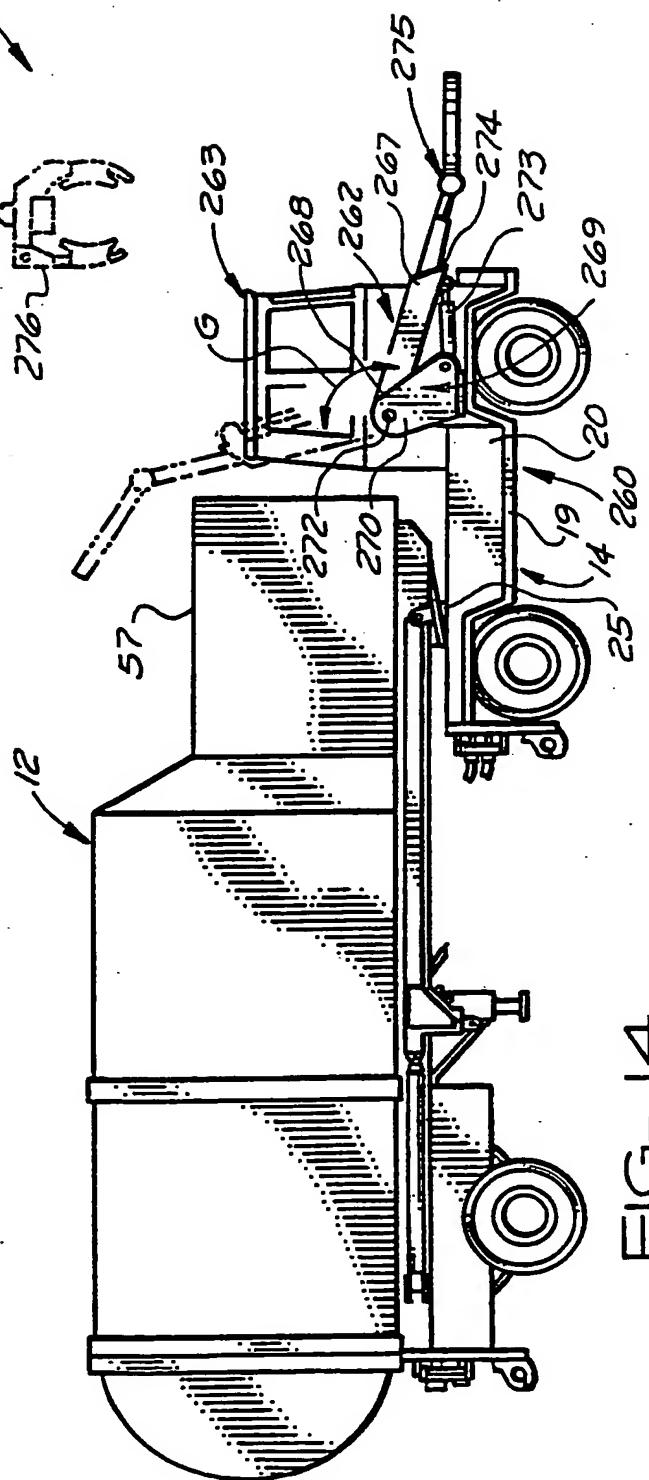
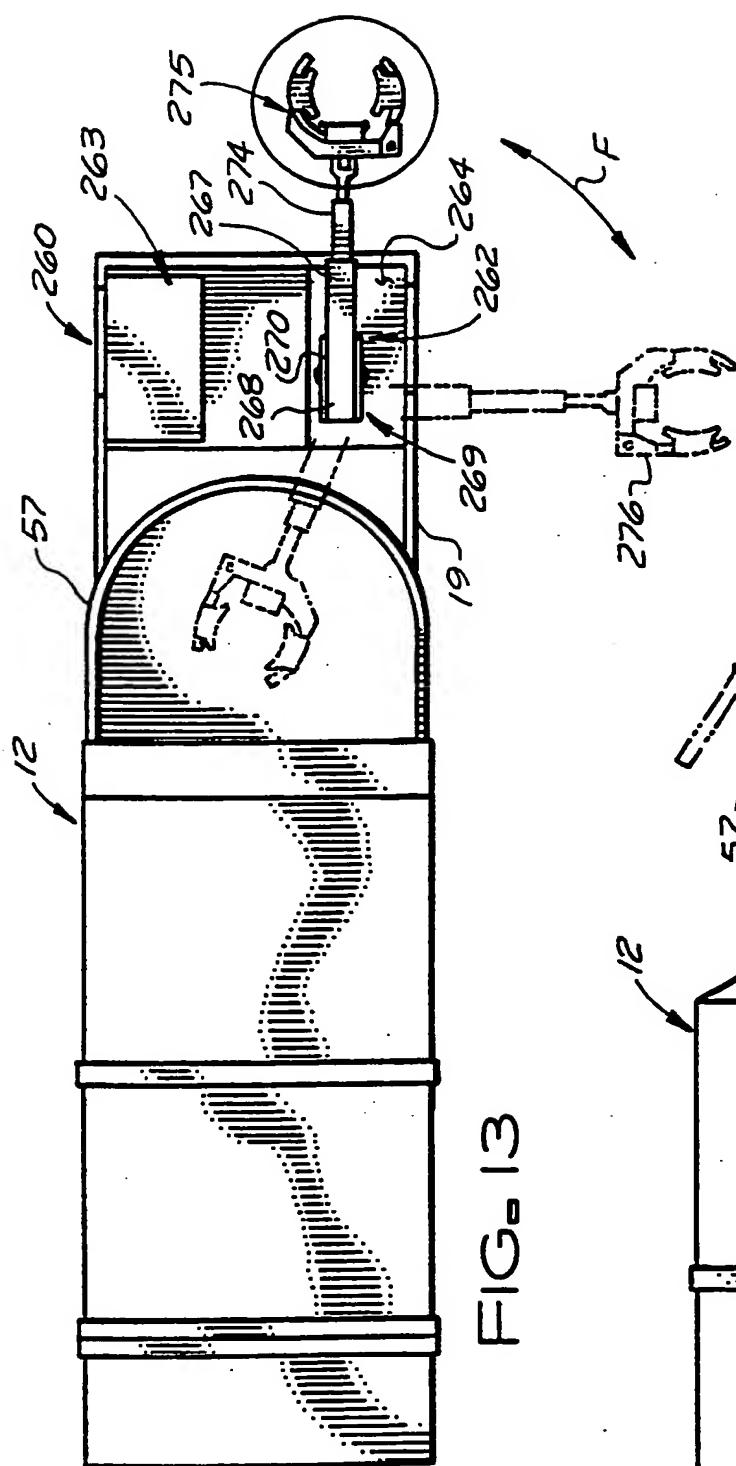


FIG. 12



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US94/02895

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : B65F 3/02, 3/14, 3/26

US CL : 414/408, 494; 280/476.1; 298/22AE

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A, 2,824,658 (Beasley) 25 February 1958 See Figure 1	1,2
--		-----
Y		3-10
Y	US,A, 4,096,959 (Schaffler) 27 June 1978 See Figures 1 and 8	3,5
Y	US,A, 4,954,039 (Johnston et al) 04 September 1990 See Figures 2,7 and 8	4
Y	US,A, 3,512,837 (Polich,Jr.) 19 May 1970 See Figures 3 and 7	6-9
Y	US,A, 4,600,210 (McMurray) 15 July 1986 See Figure 1	10

 Further documents are listed in the continuation of Box C.

See patent family annex.

•	Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"Z"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

08 JUNE 1994

Date of mailing of the international search report

JUN 24 1994

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US94/02895

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 3,071,264 (Totaro et al) 01 January 1963	none
A	US,A, 2,020,231 (Bell) 05 November 1935	none
A	US,A, 3,880,072 (Ord) 29 April 1975	none
A	US,A, 4,934,896 (Quinto) 19 June 1990	none
A	US,A, 4,552,500 (Ghibaudo et al) 12 November 1985	none

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US94/02895

**B. FIELDS SEARCHED**

Minimum documentation searched

Classification System: U.S.

414/406,408,494,500,482,483,484,415

298/22AE,20A,19R

280/476.1,411.1,408,410